U.S. ARMY TECHNICAL CENTER FOR EXPLOSIVES SAFETY

EXPLOSIVES SAFETY

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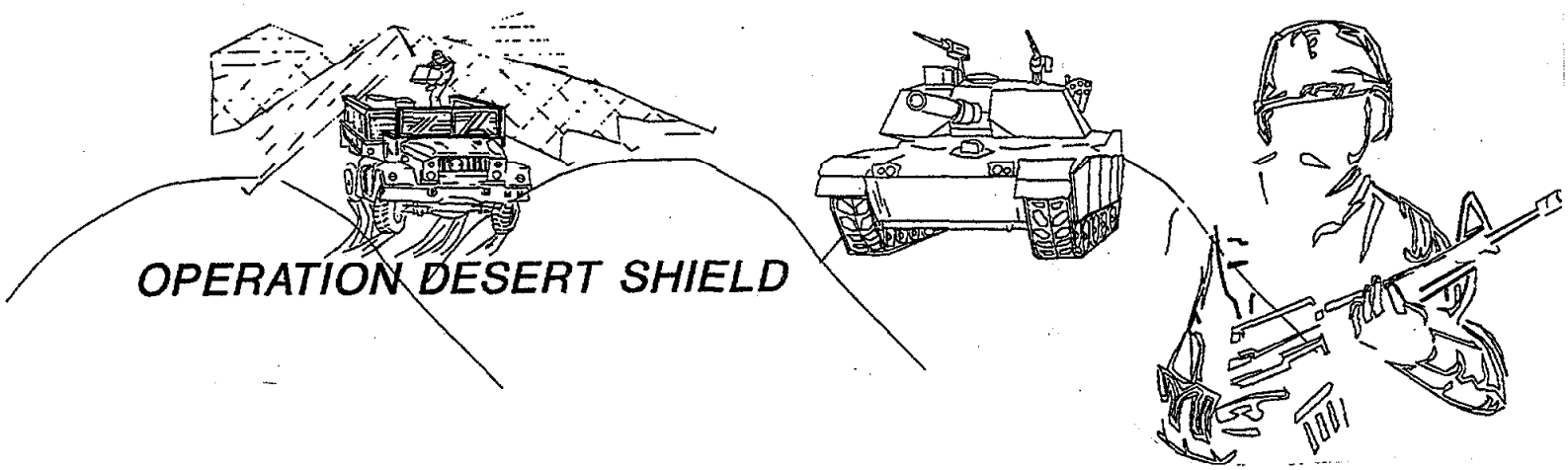

DIRECTOR'S NOTES

During the past few weeks, large tonnages of ammunition and explosives have been moved to support Desert Shield operations. Many vehicles carrying basic loads of ammunition have moved across country, through ports, and off-loaded in the Mid-East to support Operation Desert Shield. To date, no explosives accidents or incidents have occurred and this is a credit to the explosives safety community.

Many publications, articles, and bulletins are being distributed to disseminate advice and direction on moving ammunition safely. It is important to remember that only you can prevent explosives accidents. All the direction, guidance, and publications won't help unless you handle ammunition in a safe manner. If you have any unanswered questions regarding the approach to take in explosives safety, always apply the cardinal rule: Expose the minimum number of personnel to the minimum amount of explosives for the minimum amount of time.

by: John L. Byrd, Jr.
Director
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DSN: 585-8919

Most ammunition is designed to, and will, kill. This is the desired effect when used against an enemy, but cannot be tolerated when improper handling causes failure to function or accidental functioning.

Ammunition must be protected from anything that could cause it to deteriorate. That means guarding against temperature extremes, dampness, dirt, sand, rust, grease, rough handling, and anything else that could keep ammunition from doing what it's supposed to. Obvious neglect can result in unuseable ammunition. That's the story for all ammunition - from rifle cartridges to 8-inch projectiles, mines, pyrotechnics, grenades, bombs, rockets, demolition materials, and guided missiles.

This bulletin provides soldiers with tips on handling ammunition safely in a desert environment.

SAFE HANDLING

- Ammunition and explosives must be handled carefully. Improper, rough, or careless handling may set them off. Personnel working with ammunition and explosives must observe the following general safety precautions:
- Keep ammunition in containers as long as possible to prevent exposure to the elements. This is especially true of material packed in barrier bags or sealed metal containers.
- Open ammunition boxes carefully, return all inner packaging material to the container, and close to keep out blown sand.
- Repack items opened and not used.
- Do not tumble, drag, throw, roll, or containers of ammunition.
- Do not tamper, disassemble, or alter any ammunition item.
- Do not drive nails into shipping or storage containers containing ammunition.

- Do not be careless because of familiarity with munitions.
- Wear gloves when handling dark colored metal material as it may be very hot from radiant heat.
- When in doubt about the proper care and condition of ammunition, refer to TM 9-1300-206, FM 9-13, or ask the ammunition experts at the Ammunition Supply Point (ASP).

Special precautions to be taken in a desert environment are:

- Keep small arms ammunition in closed metal containers and out of the direct rays of the sun as much as practical.
- Wear protective leather or cotton gloves when handling olive drab painted small arms ammunition metal containers in the hot sun.
- Open hatches, ports, and compartments on uploaded tanks to the maximum extent possible, to allow air circulation.
- Park uploaded tanks in shaded areas when possible.
- Protect electrically initiated cartridges from static electricity. The combination of low humidity and blowing sand greatly increases the potential for static electricity generation and discharge. Use grounding cables when available.
- Store separate loading artillery projectiles in an upright position to expose less surface to the sun and to reduce the possibility of voids created by filler melting and solidifying.
- When loading unpackaged ammunition in tight quarters, such as a tank, use care not to dent the cartridge case, projectile, or fuze.
- The "jungle wrap" that ammunition is packed in softens and becomes sticky under high temperatures. Use care to prevent wax from sticking to mortar rounds which would collect blown sand and dust, increasing the probability of misfires or hang fires.
- Store propellant charges in closed containers out of the direct rays of the sun until needed.
- Handle metal containers with leather or cotton gloves to protect against radiant heat.
- Store rocket ammunition and guided missiles in a shaded area whenever possible.
- As soon as you unpack a Shillelagh missile, inspect it for explosive growth on the missile and/or blistered paint. Blistered paint may have been caused by extreme heat which could have caused explosive growth inside the missile. If either condition is noted, do not replace the missile in the container. Call EOD for assistance.

MAINTENANCE

Operator and crew maintenance is usually limited to unpacking, inspecting, cleaning, repairing packing material, and repacking. The appropriate -10, -12, or -20 series TM provides a Maintenance Allocation Chart (MAC) for authorized field inspection, care and maintenance.

UNPACKING/REPACKING

- Keep ammunition in containers as long as possible to prevent exposure to the elements. This is especially true of material packed in barrier bags or sealed metal containers.
- Watch the rough stuff when opening and closing ammunition boxes. Being careful protects ammunition in the box and saves the box for reuse.
- Place inner packing material inside outer pack, close, and save for reuse.
- Assure repackaged ammunition has the proper stock number, lot number, and quantity markings on the container.
- Return desiccant to an air tight container as soon as possible.
- Keep ammunition unitized/palletized as long as practical to allow quick handling by MHE.

INSPECTION

Ammunition doesn't always survive movement or storage in A-1 condition. It's up to your local ammunition supply point to ensure the ammunition is issued in working order. It's also up to ammunition supply to determine any added firing restrictions, which will be noted on the draw document (DA Form 581) with your ammunition.

After issue, it is up to you and your unit to inspect and care for your ammunition. Other than allowable maintenance instructions listed in the TMs MAC, unserviceable ammunition should be returned to the ASP.

Another source of advice for ammunition serviceability is the military Ammunition Inspector (MOS 55X) or civilian Quality Assurance Specialist (Ammunition Surveillance) (QASAS) (pronounced QWA'-SUS). These guys make a living knowing all about ammunition and are always eager

to help. Just ask your ammunition supply people how to find them.

Obvious damage such as dents, cracks, and bulges to critical surfaces like cartridge cases require turn-in. Slight dents or bumps may be okay if the round seats correctly in the weapon. Damage to less critical surfaces such as mine or grenade cases are acceptable if internal components or fuze cavities are not affected.

The same applies to rust and corrosion. Unless the condition could affect functioning, it is acceptable. Wipe down exposed ammunition frequently to fend off rust or corrosion.

Never fire ammunition that's been watersoaked.

The -10, -12, and -20 series TMs provide inspection criteria, and direct turn-in of ammunition not meeting field standards.

CLEANING

Sand, moisture, and oil are your ammunition's chief enemies. Dirty or corroded ammunition can jam your weapon or cause misfires. Wet ammunition may not fire. Oil or grease on ammunition can cause it to malfunction or even flashback and set you on fire. If you spot oil or grease on your ammunition, clean it off. If it won't come off, turn the rounds in to the ASP.

In a desert environment, one of your best ammunition PM tools is a clean, lint-free rag. Normally, a frequent going over with a clean rag can keep your ammunition in prime condition. Is also is a good way to head off corrosion.

Do not clean ammunition with oil, solvents, water, or steel wool.

PAINTING/STENCILING

If your unit has the okay to touch-up paint your ammunition, check the TM for authorized paints, thinners, and other supplies. Use a light touch with the paint - no extra coats, and no coats just for looks. Uneven, layered painting could keep ammunition from chambering properly. If in question, check with your QASAS or MOS 55X.

Painting over surfaces (bourrelet of artillery ammunition) or ID markings is critical. Excess paint on the bourrelet may cause the round not to chamber. Covered ID markings must be replaced immediately to prevent loss of identity or erroneous markings. The lot number is an especially important ID for all ammunition.

The lot number tracks the history of the ammunition and is the tool for separating good ammunition from suspended or restricted ammunition.

When the ammunition lot number is lost, the ammunition is unserviceable and must be turned in to the ASP. Ammunition incorrectly identified; e.g., training ammunition marked as HE, could be deadly to the user.

As a field expedient, use magic markers to reapply light ID markings to rounds and packing materials. Handwritten markings are better than none at all.

REPAIR PACKING MATERIAL

- Repair only empty containers.
- Do not repair ammunition boxes or containers within 30 meters of an ammunition stack.
- ID markings on boxes and containers are also important. When you're repairing or cleaning a box or container, protect the markings or re-do them PDQ.

AMMUNITION STORAGE

Ammunition storage conditions vary between the ASP where large quantities are stored in magazines and field storage, where smaller quantities are stacked outside in MILVANs or aboard combat vehicles. Hazards of the various munitions must be considered in all these storage environments. You want to be able to quickly access the different types of ammunition and explosives, but safety factors restrict storage quantity mixing and distance separation. Quantity distance (QD) and storage compatibility standards for setting up and operating ASP and field storage can be found in TM 9-1300-206. Accountability and record keeping will be in accordance with DAP 710-2-1, FM 9-38, and appropriate Standard Army Ammunition System (SAAS) regulations. To prevent chain explosions and loss of all your ammunition, place ammunition stacks a safe distance apart. Remember TM 9-1300-206 has the rules for this. Other safety factors are:

- Point all boxes or containers in a stack in the same direction, leaving the ammunition ID clearly in view.
- Isolate rockets into single rows, all pointing into an embankment or some sort of barrier (never towards billets).
- Store all white phosphorus (WP) and plasticized white phosphorus (PWP) ammunition in an area by itself. Artillery ammunition will stand nose up. This is critical in areas where temperatures reach 111 degrees Fahrenheit. Store WP munitions nose up or down, but never lying down on its sides.
- Observe mixing compatibility requirements for conventional ammunition.
- Plan the storage of complete rounds and components so they are placed in more than one location within the storage area. Place them far enough apart so that if a stock blows up or catches fire, it won't destroy the entire stock of that item.
- Bombs must be stored so that fuze wells can be inspected. Bomb fuzes and primer detonators will be stored separately from bombs.
- Improved conventional munitions (ICMs) present special hazards if the cargo is ejected and armed.

Store on the perimeter of the storage area to reduce hazards.

- Vehicles and trailers loaded with explosives should be parked 250 feet or more from vehicles and trailers transporting flammable liquids or cargo vehicles loaded with packaged gasoline, diesel fuel, and similar flammable liquids.

- To safely store temporarily downloaded tank main gun ammunition, a special rack may be built which limits a potential explosion in the rack to only one round and contains all fragments, thus protecting nearby personnel and equipment. Plans for this rack are being distributed by the U.S. Army Technical Center for Explosives Safety, ATTN: SMCAC-ESL, Savanna, Il 61074-9639, DSN 585-8801 or commercial (815) 273-8801.

- Post the appropriate fire and/or chemical hazard symbol(s) for each magazine or field storage unit (FSU), reference TM 9-1300-206.

OPEN STORAGE OF AMMUNITION AND GUIDED MISSILES IN A HOT DESERT CLIMATE

Storage of ammunition and guided missiles at the high temperatures that will be experienced in Desert Shield may have serious effect upon the functioning and safety of the materiel. Every effort must be made to reduce the temperature at which ammunition is stored.

Weather data available for various locations within the region indicate that air temperature often exceeds 115 degrees Fahrenheit (46 degrees Celsius). This temperature is air temperature only and may not be indicative of the temperature of the internal components of ammunition items, particularly those in metal containers, due to the effects of solar radiation. An air temperature of 115 degrees Fahrenheit (46 degrees Celsius) may cause the internal temperature of an ammunition item to be significantly higher. Desert test data available shows that, due to solar radiation, temperatures can be as much as 90 degrees higher than the ambient air temperature when materiel is fully exposed to the sun, 95 degrees higher when materiel is covered with tarpaulins in contact with the ammunition, and 50 degrees higher when materiel is shaded. Proper covering/shading of ammunition will reduce the effects of increased temperature due to solar radiation while improper covering of ammunition may cause its internal temperatures to be higher than if the ammunition was not covered at all! Proper covering/shading is important!

Storage temperature upper limits indicated for various ammunition items in their respective TM 43 series manuals are misleading because they do not address the consequence of long term storage, intermittent storage, temperature rate of change, etc., regarding the upper limits specified. Some limitations specified are qualified by stating that the temperature should not be reached or exceeded for periods of more that 4 hours/day. However, the consequence of exceeding the limit in terms of duration, frequency, and cumulative effect are unknown. Temperature limitations specified in the TM 43 series manuals vary significantly from 160 degrees Fahrenheit (71 degrees Celsius) for many artillery items to 115 degrees Fahrenheit (46 degrees Celsius) for certain grenades. These temperature limits are air temperatures only. Depending upon the storage configuration, level of solar radiation, etc., the internal temperature of the ammunition item may be significantly higher than the air temperature. There are no practical means to measure internal temperatures in the field.

Specific recommendations regarding storage are as follows:

Tarping/shading of ammunition:

- All ammunition stored in the open should be tarped/shaded with as light colored tarps/nets as possible. This will decrease absorption of radiant heat.

- All tarps erected will be built to allow quick lowering of the tarp in the event high winds are encountered.

Storage on the ground:

- All ammunition stored on the ground will be on pallets or dunnage to allow a minimum of 3 inches clearance above the ground. Blown sand will be cleared away.

- Ammunition stored on sandy soil will not be stacked over two pallets high in order to ensure stack stability. Stack heights can be altered to meet local conditions.

- A minimum of 3 inches clearance on all sides of stacks will be provided for ventilation purposes. Blown sand will be cleared away.

- All white phosphorus (WP) projectiles must be stored in a base down orientation. WP will melt and shift, causing a ballistically unstable projectile. Units are reminded of firing temperature limit for D528, 155MM SMK WP M825. Normal maximum firing temperature limit is 145 degrees Fahrenheit (62 degrees Celsius). However, lots manufactured from January 1985 through May 1986 are restricted from firing above 110 degrees Fahrenheit (43 degrees Celsius). This includes lot numbers beginning with PB-85A through PB-86E.

- Proper covering/shading of ammunition should be prioritized according to the need to minimize temperature in order to ensure the serviceability and safety of the item. Those items most susceptible to the effects of high temperatures and humidity; e.g., propelling charges, fuzes, pyrotechnics, guided mis-

siles, and rockets should be given the highest priority for proper protection. Covering ammunition in a desert environment with a tarpaulin placed directly on the ammunition will cause the item to experience higher temperatures than if it were not covered at all. A minimum of 18 inches of air space above the ammunition is essential.

- Although pallet/box/container configuration allows for some ventilation, unpalletized ammunition should be stored in a manner that permits as much ventilation between individual rounds/boxes/containers as is practical as shown in TM 9-1300-206.

Storage of ammunition in vehicles:

- All armored vehicles with ammunition aboard will be left open to the maximum extent possible to allow for ventilation.
- Wheeled vehicles with closable compartments where ammunition is stored will be left open when possible to allow for ventilation.
- Trucks with open cargo areas will have pallets or ammunition placed with space between individual boxes or pallets.
- Vehicles should be parked to take advantage of any shade provided by buildings, sheds, or covered parking provided the safety of personnel is not violated.

Ammunition packaging:

- Relatively high humidity prevails in the region and varies throughout the day. Ammunition should remain in its packaged configuration until immediately prior to use.
- Items opened and not used will be repacked as soon as possible. Desiccant should be saved from desiccated items and returned to the box when the items are repacked.
- Special care will be taken not to open propelling charge, guided missile, or rocket containers, or items packed in barrier bags until the last possible moment, as these items are extremely susceptible to humidity.

The U.S. Army Defense Ammunition Center and School (USADACS) is investigating various methods of providing field expedient covers for ammunition in field ammunition supply points (ASPs). Information will be provided as it becomes available.

FIRE SAFETY

- Do not carry fire producing items (matches, lighters, etc.) into ammunition storage areas.
- Do not smoke in ammunition storage areas.
- Do not allow waste materials or litter to accumulate in storage areas. Waste materials include oily rags, solvents, lubricants, paper, and explosive scraps.
- Be familiar with the location of fire points within storage areas.
- Be familiar with the fire plan and the organization of the storage area's firefighting crew.

MOTOR VEHICLE MOVEMENT

- Any vehicle used to ship ammunition, or one that even goes near ammunition, must be in tip-top condition. That means all systems must be working smoothly. The vehicle must also be clean: No stains from leaking fuel, lube, grease, or anything else. Stains attract dirt and oily dirt could create a fire hazard.
- Crew level maintenance may be performed on a vehicle loaded with ammunition without unloading the ammunition. Higher level maintenance and maintenance involving heat or flame producing devices requires that the ammunition be off-loaded and moved at least 50 feet from the operation.
- Fuel up your vehicle before you load it with ammunition, if possible, and as far away from ammunition as possible. If you must refuel a loaded vehicle, do the job in an isolated spot.
- When tactical situations permit, refueling operations should be delayed until the engine has cooled for at least 10 minutes to lessen the danger of automatic ignition from spills or overflows.
- Mark your load off limits to riders, visitors, and especially smokers.
- A must for any vehicle carrying ammunition is two serviceable carbon dioxide fire extinguishers rated 10BC or higher.
- A good checklist for trucking ammunition is DD Form 626, Motor Vehicle Inspection, and DD Form 836 provides Special Instructions for Motor Vehicle Drivers.
- Placard ammunition loaded motor vehicles in accordance with TM 9-1300-206 and local/national requirements.

STORAGE OF AMMUNITION AND GUIDED MISSILES IN MILVANs AND COMMERCIAL CONTAINERS

Test data available indicate that the interior temperature of MILVANs, commercial containers, and similiar metal containers will be significantly higher than ambient exterior air temperature when exposed directly to the sun. This condition is especially significant in the hot-dry desert, intermediate hot-dry desert, and hot-humid coastal desert regions in Saudi Arabia.

The effects of the intense solar radiation must be minimized to the maximum extent possible if MILVANs containing ammunition and guided missiles are subject to the sun for extended periods. Solar radiation effects can be reduced by shading using tarpaulins, camouflage nets, other covers, etc., and by the orientation of the container. Utilization of MILVANs for storage is not desirable but when necessary the following steps should be taken.

- Shade the container with a cover that is at least 18 inches from the top, sides, and ends of the container to allow for circulation of air.
- Containers should be positioned with the long axis (20 feet) oriented in an east-west direction to minimize the east and west wall exposure. The low altitude morning sun and low altitude afternoon sun will be directly on the short axis (8 feet) in this orientation. Maximum shading should be provided the top of the container due to the very high angle of the sun because of low latitudes.
- Doors should remain open to permit ventilation when operating and security considerations permit.
- Sand and/or sand bags should be placed against the sides and rear of a container planned for extended use but should not cover the container. Care should be exercised so as not to damage the container and its contents. Placement of sand/sand bags in this manner will greatly reduce the cover (tarps, nets) required by reducing the surface area exposed to the sun. A 20-foot x 40-foot tarpaulin would adequately cover an exposed container.
- If no subsequent movement of the container is planned, mechanical restraints, blocking and bracing, etc., can be removed. Blocking and bracing lumber may be used to provide the standoff (separation) between the top/sides of the container and the cover used.
- Shading of containers should be prioritized so that items most susceptible to deterioration due to heat; e.g., guided missile/rockets, propelling charges, pyrotechnics, white phosphorous (WP) filled items, etc., are given first consideration.

MILVAN storage of ammunition must be considered as an unbarricaded aboveground magazine for quantity distance (QD) purposes. Separation distances among containers and between containers and external exposures, must be determined accordingly to prevent propagation of an unintended explosion from one container to another; protect personnel from death or injury; and protect equipment/facilities from damage. Reduced distances increase the hazard. Use of terrain features or barricades between containers may allow reduction of separation distances.

AIRLIFTING AMMUNITION

Specific Sling-out Area Requirements:

- Locate helicopter sling-out areas at least 550 meters from ammunition storage structures, inhabited buildings/personnel areas, or other vital facilities.
- Consider prevailing winds in the sling-out site selection. Select a site that helicopters could normally approach and depart without flying over magazines, inhabited buildings/personnel areas, or other vital facilities. Provide a windsock or other wind direction indicator so that chopper pilots can determine the current wind direction. Smoke grenades or open fires will not be used to establish wind direction.
- The sling-out area must have a good earthen ground. Helicopters must be grounded and personnel must touch the grounding cables to bleed off any static charge prior to loading. A hovering helicopter must be grounded by using a grounding wand (shepherd's crook) prior to the hookup of the cargo net.
- The sling-out area is not to be used for long-term storage of ammunition. The only ammunition that should be present is the load the last helicopter just left or the load the next helicopter is about to pick up.
- Have the ammunition on cargo nets ready to be slung out prior to the arrival of the helicopter. If possible, have the loads made-up on cargo nets prior to arrival at the sling-out point.
- Assure adequate firefighting equipment is available and MHE is clear of the area prior to the arrival of the helicopter.

For more information on load limits, safety, grounding, and ammunition compatibility, see TM 38-250, Packaging and Handling of Dangerous Materials for Military Air Shipment and/or TM 9-1300-206

AMMUNITION PORT OPERATIONS

Normal safe handling precautions should be taken during port loading/unloading operations. The following requirements apply to port operations conducted in high temperatures:

- Munitions should be given higher priority for protected dock-side storage than weapons.
- Since excessive heating can result in increased sensitivity of explosive materials, care should be exercised during movements dockside, both on-loading and down-loading of vessel(s). Do not store any ammunition with a storage temperature threshold of 130 degrees Fahrenheit or lower in the direct sun without tarping/shading, aboveground blocking, and adequate ventilation.
- Keep pre-loading and off-loading times on dockside to a minimum to avoid solar overheating. Downloading and uploading should be done in the early morning as first choice or after sundown as second choice to minimize overheating.
- Open doors to ammunition in MILVANs to the maximum extent possible to allow for ventilation.
- Orient ammunition-loaded MILVAN east-west to minimize container surface exposure to direct sun rays.
- Provisions should be made for the construction of shelters, on or within close proximity to, all on-load/off-load operations. Most desirable are shelters providing complete protection from solar radiation with designs that optimize ventilation.

AMMUNITION RECOVERY

Obey these rules - they can be life savers:

- Never discard unserviceable ammunition. It can come back to haunt you. Report it or turn it in.
- Never abandon unused ammunition. Return it to storage or turn it in to ammunition supply.
- Never handle duds. A nudge can instantly change their dud status. Report duds immediately to EOD.
- While training, collect and return fired brass, aluminum casings, and empty ammunition containers to the ASP for recycling and/or reuse.
- Segregation operations at the ASP call for the unit turning in material to inspect residue 100 percent for live explosives/munitions. A certification statement that the material is free-of-explosives will be added to the turn-in documents.

ACKNOWLEDGEMENTS

We gratefully acknowledge the contributions of the following organizations to the EXPLOSIVES SAFETY BULLETIN:

U.S. Army Armament, Munitions and Chemical Command

U.S. Army Missile Command

Material Readiness Support Activity

U.S. Army Defense Ammunition Center and School

The EXPLOSIVES SAFETY BULLETIN targets the ammunition/explosives community. It is printed in Savanna, Illinois.

If you wish to submit an article that is of interst to the ammunitions/explosives community, or if you have a request for more copies of the bulletin, please forward it to: Director, U.S. Army Technical Center for Explosives Safety, ATTN: SMCAC-ES, Savanna, IL 61074-9639.

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POINTS OF CONTACT

The following are the office addresses and telephone numbers to notify when inter-service explosives safety issues arise:

ARMY: *The Army has identified two locations. Either is acceptable for notification and proper coordination will follow a request.*

- Office of the Chief of Staff, U.S. Army, ATTN: DASC-SF, Washington DC 20310-0200, DSN: 225-7291/7294, commercial (703) 695-7291/7294
- Director, U.S. Army Technical Center for Explosives Safety, ATTN: SMCAC-ES, Savanna, Il 61074-9639, DSN 585-8919, commercial (815) 273-8919.

NAVY: *The Navy has identified two locations. The top address should be contacted for policy issues; the bottom address should be contacted for technical issues.*

- Chief of Naval Operations, ATTN: N411 (OP411), Washington, DC 20350, DSN 225-7094, commercial (703) 695-7094
- Commander, Naval Sea Systems Command, ATTN: SEA 665, Washington, DC 20362-5101, DSN 332-2080, commercial (703) 602-2080.

AIR FORCE:

Headquarters, Air Force Safety Agency, ATTN: SEWV, Norton Air Force Base, CA 92409-7001, DSN 876-3137, commercial (714) 382-3137

MARINE CORPS:

- Marine Corps Systems Command, ATTN: AM, Washington, DC 20830, DSN 226-0924, commercial (703) 696-0924.

EXPLOSIVES ACCIDENT STATISTICS FIRST & SECOND QUARTERS FY 93

TYPE	NUMBER	DAMAGE COST	INJURY COST	TOTAL COST
A	0	0	0	0
B	3	$906	$499	$1,405
C	16	$339	$132	$471
TOTAL	19	$1,245	$631	$1,876

The above explosives accident statistics are a compilation retrieved from the Army Safety Management Information System (ASMIS) Retrieval and Processing System (ARPS) using the search criteria for explosives types. These FY 93 statistics represent explosives accidents reported to USASC on DA Form 285, U.S. Army Investigation Accident Report.

NOTE: The above amounts are in thousands of dollars.

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